

**PART 582 - GRADE STABILIZATION STRUCTURE - 410
AND STRUCTURE FOR WATER CONTROL - 587**

KS582.00 Reinforced Concrete Box Drop Structures

- (a) Standard plans will be used where applicable. If not available, the plan must then be approved by an engineer having the appropriate approval authority.
- (b) Structures of this type will be constructed from concrete. This section does not apply to structures fabricated from rock, masonry, concrete block, steel, aluminum, plastic or treated wood.
- (c) Design will be in accordance with the guidelines in National Engineering Handbook (NEH), Sections 5, 6, 11 and 14; Engineering Field Manual, Chapter 6 (including the Kansas Supplement to this chapter) and the criteria listed in the Kansas Standards and Specifications for Grade Stabilization Structure - 410 and Structure for Water Control - 587.

KS582.01 Design Survey

(a) Record survey data on Forms NRCS-ENG-28 and NRCS-ENG-29 (loose leaf field notebook) or KS-ENG 37 and KS-ENG-37a. Record the information indicated below. Survey notes should follow the format shown on pages KS582-9 through KS582-11.

- (1) Complete identification information on the front side of Form NRCS-ENG-28 or KS-ENG-37.
- (2) Record the profile survey notes. Take readings along the centerline of the channel at all significant changes in slope and direction but do not exceed 100 feet (30.5 m) between shots. Start the survey at least 300 feet (91.4 m) upstream from the structure and extend it at least 1000 feet (304.8 m) downstream, to the confluence with a major stream or to a bridge or culvert downstream which will restrict flow.

(3) Record cross section survey notes. Take readings perpendicular to the profile. Take a cross section 50 feet (15.2 m) to 100 feet (30.5 m) upstream, one along the centerline of the proposed structure site and one downstream 50 feet (15.2 m) to 100 feet (30.5 m). Take a minimum of one additional cross section downstream, at the lower end of the profile. The cross sections should extend to an elevation above the expected high water mark during the passage of the design storm. Also, a cross section is needed below the convergence with a stream.

(4) Record profile along centerline of the dike. Take readings along the centerline of the dike at all significant changes in slope and direction but do not exceed 100 feet (30.5 m) between shots. The profile should extend to an elevation above the expected top of dike.

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(5) Set a bench mark for each structure. Record the elevation and description of the bench mark. If more than one instrument setup location is required to complete the survey, the survey must be closed by returning to the bench mark.

(b) Complete a soil boring log of the test holes at the structure site if required for sound construction. Form NRCS-ENG-533, Log of Test Holes, can be used in lieu of recording this information in the field notes.

(c) While in the field completing the survey, check for signs of utilities in the construction area. If utilities are known to exist, safety procedures listed in National Engineering Manual Part 503 should be strictly followed.

KS582.02 Design and Layout

(a) Hydrology - Use Form KS-ENG-137, Hydrologic Summary Sheet, Engineering Field Manual, Chapter 2 (EFM2) computer program, or Technical Release (TR) 55, Urban Hydrology for Small Watersheds computer program to record the hydrologic data for the structure and to compute the peak discharge in cubic feet per second (cfs) for each structure. Use Table 2 in the Kansas Standard for Grade Stabilization Structure - 410 to determine the appropriate design storm. An example of the EFM2 computer program printout is shown on pages KS582-7 and KS582-8.

(b) Hydraulic Design - When using the standard plans for reinforced concrete box drop spillway in the Kansas Supplement to Chapter 6 of the Engineering Field Manual, complete Form KS-ENG-444(JS) to document the hydraulic design of the structure. Record the following items on the sheet. A sample of the completed Form KS-ENG-444(JS) is shown on page KS582-12. Each circled number on the form corresponds to the numbered item below:

- (1) Name of landuser
- (2) Legal description of field
- (3) Tract number or any identification assigned to field
- (4) County name
- (5) Signature of the person performing the design and the date
- (6) Signature of the person checking the design and the date
- (7) Signature of the person approving the design and the date
- (8) Signature of the person completing the layout and the date

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(9) Indicate the status of any utilities in the construction area. Indicate "yes" if utilities are present and "none known" if there are no records, maps or on-site markers that indicate the presence of utilities.

(10) Complete the location map, showing the location of the structure and any other pertinent features such as waterways, streams, roads, farmsteads, utilities, etc.

(11) List the scale of the location map

(12) Complete the "Channel Profile"

(13) Complete the "Profile Along Centerline Dike"

(14) Complete the "Design Storm" frequency and discharge from the information obtained in KS582.02(a). "Hydraulic Capacity (Qa)" is the cfs from the line used for design on the Guide Plan for Completing KS-ENG-444(JS) and KS-ENG-445(JS) sheet 2 of 2.

(15) Complete the "Overfall Height (d)." Determine the appropriate crest and floor elevations for each structure. The crest of each structure must be at an elevation that provides for a stable upstream channel slope. The floor must be at an elevation that provides for adequate tailwater and a stable downstream channel slope. The "Overfall Height (d)" is the difference between the crest elevation and the floor elevation and must be 3.0, 4.0 or 5.0 feet (0.9, 1.2, or 1.5 m).

(16) Select the appropriate structure dimensions from the Guide Plan for Completing KS-ENG-444(JS) and KS-ENG-445(JS) sheet 2 of 2 using the "Design Storm" discharge and the "Overfall Height (d)" from KS582.02(b)(14) and (15). Complete "Available Tailwater Depth" using tailwater documentation.

(17) In the "Emergency Spillway Design" section, complete the "Design Storm" frequency and discharge from the information obtained in KS582.02(a). If an emergency spillway is required by the Kansas Standard for Grade Stabilization Structure - 410, design the emergency spillway according to the procedure outlined in the Engineering Field Manual, Chapter 11, and the Kansas Standard for Grade Stabilization Structure - 410.

(c) Complete Form KS-ENG-445(JS) to document the inlet and outlet protection details, backfill details, bench mark description and the table of quantities. Record the following items on the sheet. A sample of the completed Form KS-ENG-445(JS) is shown on page KS582-13. Each circled number on the form corresponds to the numbered item below:

(1) Name of landuser

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(2) Legal description of field

(3) Tract number or any identification assigned to field

(4) County name

(5) Select the appropriate outlet protection option based on the available tailwater depth immediately below the structure by completing the procedure outlined in the National Engineering Handbook Series, Part 630, Chapter 31, Computer Program for Water Surface Profiles (WSP2), calculating the normal depth of flow using the procedure outlined in the Engineering Field Manual, Chapter 3, for open channel flow; or manual calculations may be used to document tailwater depth. If the available tailwater is greater than that required for the "Unarmored Tailwater Depth (D2)" on the appropriate line in the table on the Guide Plan for Completing KS-ENG-444(JS) and KS-ENG-445(JS) sheet 2 of 2, then no outlet protection is required.

(6) Select the appropriate inlet protection option from the available alternatives. Inlet protection is required on all structures.

(7) Complete the table of quantities. With the exception of the Seeding and Excavation, Earthfill, quantities can be obtained from the Guide Plan for Completing KS-ENG-444(JS) and KS-ENG-445(JS) sheet 2 of 2, and Guide Plans for Completing KS-ENG-446, KS-ENG-447 or KS-ENG-448 for concrete volume and steel weight. Determine the Seeding and Excavation, Earthfill, quantities using appropriate engineering calculations and attach them as supporting documentation.

(8) Complete the "Benchmark Description" and "Elevation."

(d) Complete Form KS-ENG-446(JS) for 3.0 feet (0.9 m) overfall height, Form KS-ENG-447(JS) for 4.0 feet (1.2 m) overfall height or Form KS-ENG-448(JS) for 5.0 feet (1.5 m) overfall height to document the structural design and steel schedule. Record the following items on the appropriate sheet. A sample of a completed Form KS-ENG-446 is shown on page KS582-14. Each boxed number on the form corresponds to the numbered item below. The same procedure will apply for Forms KS-ENG-447(JS) and KS-ENG-448(JS).

(1) Name of landuser

(2) Legal description of field

(3) Tract number or any identification assigned to field

(4) County name

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(5) Complete the headwall length, steel schedule and concrete quantities by transferring the appropriate values from the Guide Plans for Completing KS-ENG-446(JS), KS-ENG-447(JS) or KS-ENG-448(JS) depending on the overfall height of the structure.

(6) Complete the structure dimensions by transferring the appropriate values from the "Steel Schedule." Mark 1, 4 and 7 bars are to use 1/2 quantity in steel schedule when filling in number of bars in drawing.

(7) Complete "Crest Elev." and "Floor Elev."

(e) Prepare specifications to supplement the design sheets. The specifications will state the technical and workmanship requirements for the operations and state the quality of materials to be incorporated into the structure. The specifications, pages S-410-3 through S-410-8, of the Kansas Standard and Specifications for Grade Stabilization Structure - 410 may be used. Section 16, Construction Details, will contain the requirements for other items not covered in the drawings or specifications. If these pages do not fit the individual situation, then they may also be used as a guide to write a set of specifications that better fit the individual job.

(f) Layout of the structure will consist of setting stakes to show the following:

(1) Location of the structure

(2) Elevation and dimension of all elements of the structure including inlet channel, outlet channel, spillways, dikes, etc.

(g) Where embankment fill is used in conjunction with the structure, follow the documentation procedures listed for the Kansas Standard for Pond - 378. Take standard slope stake notes for the earthfill and set slope stakes. Use the field sheet for dams, Form KS-ENG-4. The quantity section on the back of Form KS-ENG-4 need not be filled out if printer output from an approved computer program is attached. Proper notation shall be made on the field sheet if this method is used.

KS582.03 Construction

(a) During construction of the structures, periodic inspections need to be made by NRCS personnel. At a minimum, an inspection needs to be made of the forms and steel placement prior to the concrete pour. The forms should be inspected to ensure that the structure will meet the dimensions as set forth in the drawings and specifications. The reinforcing steel and welded wire fabric should also be inspected to ensure it is the proper size, it is placed correctly and all splice requirements are met.

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(b) It is advisable to be present during the concrete pour to ensure that all specifications are being followed. During the pour, it is important to ensure that the reinforcing steel and welded wire fabric is held in place in the middle of the concrete. Also during the concrete pour, the concrete must be consolidated by vibration, tamping or spading to eliminate all air voids.

KS582.04 Checkout

(a) Perform profile surveys on the channel centerline and centerline of the dike. Record the information indicated below on Form NRCS-ENG-28 or KS-ENG-37.

(1) Elevation readings on top of the head wall, crest, floor and any other place affecting the performance of the structure

(2) Standard checkout notes for embankment fills and channel excavations using the procedure documented in the Kansas Standard and Specifications for Pond - 378.

(b) Record the measured dimensions of each structure in survey notes and as "AS-BUILT" notations on original copies of the plans.

(c) Record dates and signatures of persons checking out and auditing the checkout.

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KS582.05 Sample of the EFM-2 Computer Program Printout

EFM-2 ESTIMATING RUNOFF AND PEAK DISCHARGE VERSION 1.00

Client : S. M. FARMER By: JBG Date: 01-25-96
 County : RENO State: KS Checked: CCJ Date: 1-29-96
 Practice: REINFORCED CONCRETE BOX DROP STRUCTURE

Drainage Area : 53 * Acres
 Curve Number : 85 *
 Watershed Length : 2150 Feet
 Watershed Slope : 3 Percent
 Time of Concentration: .478 Hours
 Rainfall Type : II

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	2	5	10	25	50	100	0
24-Hr Rainfall (in)	3.2	4.2	5	5.8	6.6	7.4	0
Ia/P Ratio	0.11	0.08	0.07	0.06	0.05	0.05	0.00
Used	0.11	0.10	0.10	0.10	0.10	0.10	0.00
Runoff (in)	1.76	2.64	3.37	4.11	4.87	5.64	0.00
Unit Peak Discharge (cfs/acre/in)	0.838	0.845	0.845	0.845	0.845	0.845	0.000
Peak Discharge (cfs)	78	118	151	184	218	253	0

* - Value(s) provided by CN subroutine (F9)

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EFM-2 ESTIMATING RUNOFF AND PEAK DISCHARGE
 Curve Number Computation

VERSION 1.00

Client : S. M. FARMER By: JBG Date: 01-25-96
 County : RENO State: KS Checked: CCJ Date: 1-29-96
 Practice: REINFORCED CONCRETE BOX DROP STRUCTURE

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
AMC CONDITION				
AMC I + .8 (II-I) Fallow	-	-	44 (86)	-
AMC I + .8 (II-I) Row Crop (Contoured)	-	-	9 (79)	-
Total Area (by Hydrologic Soil Group)			53	
			=====	

TOTAL DRAINAGE AREA: 53 Acres WEIGHTED CURVE NUMBER: 85

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KS582.06 Sample of Form NRCS-ENG-28 - Field Notes for Reinforced Concrete Box Drop Structure Design Survey

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE																					
SCD Reno Co.	Date 1-25-96																				
Field Office Hutchinson																					
Name SM Farmer																					
① Individual Group Unit of Govt. (circle one)																					
Job GSD																					
Design Sur. <input checked="" type="checkbox"/>	Const. Layout																				
Const. Check	Other																				
Ident. No. 1440	Field No.																				
<table border="1"> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td> </td><td> </td></tr> <tr><td colspan="2" style="text-align: center;">Structure site</td></tr> <tr><td>Scale</td><td>1" = 1320'</td></tr> <tr><td colspan="2"> </td></tr> <tr><td colspan="2">Legal Description</td></tr> <tr><td colspan="2">SW 1/4 Sec Z T Z Z R Z</td></tr> <tr><td colspan="2">Location:</td></tr> </table>										Structure site		Scale	1" = 1320'			Legal Description		SW 1/4 Sec Z T Z Z R Z		Location:	
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Scale	1" = 1320'																				
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SW 1/4 Sec Z T Z Z R Z																					
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SCS-ENG-28 REV. 5-73

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KS582.07 Sample of Form NRCS-ENG-29 - Field Notes for Reinforced Concrete Box Drop Structure Design Survey

Grade Stab. Structure				
Station	B.S.	H.I.	F.S. or grade rod	Elev. or planned elev.
BM 1	6.2	106.2		100.0
<i>Channel Profile</i>				
0+00		8.0	98.2	
1+00		8.5	97.7	
2+00		9.1	97.1	
3+00		11.9	94.3	
40				
3+40		12.3	93.9	
60				
4+00		12.4	93.8	
75				
4+75		12.6	93.6	
5+75		12.7	93.5	

SCS-ENG-29 (2-80)

GPO : 1982 O - 369-853

SM Farmer	(2)	π J. Good
Grade Stab. Structure		# C. Jones
Design Survey		1-25-96
Top of 5/8" steel rod 120' NW		
of channel profile Station 1+00		
Left	E	Right
10.4	10.0	11.0
8.8	9.0	9.8
4.8	7.1	7.6
80'	20'	40'
8.0	8.0	8.0
20'	40'	20'
10.0	10.0	10.0
5.2	8.6	9.4
80'	20'	80'
12.3	12.3	12.3
9.6	9.6	9.6
90'	80'	90'
5.1	5.1	5.1
10.0	10.0	10.0
9.8	9.2	9.8
100'	20'	70'
12.6	12.6	10.1
10.1	8.9	8.9
70'	10'	70'
8.9	8.9	8.9
20'	100'	20'
Flowline of stream		

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KS582.08 Sample of Form KS-ENG-444(JS)

USDA-NRCS		KS-ENG-444(JS) 1-76																							
Designed By <u>John B. Stord</u> (5)	Date <u>1-26-96</u>	Design Checked <u>Charles Cawie</u> (6)	Date <u>1-29-96</u>																						
Approved By <u>Charles Cawie</u> (7)	Date <u>1-29-96</u>	Licensed By <u>Robert G. Stord</u> (8)	Date <u>1-31-96</u>																						
Utilities present <input checked="" type="checkbox"/>	None known (9)																								
REINFORCED CONCRETE BOX SPILLWAY																									
Structure Location																									
Scale: <u>1" = 660'</u>																									
N																									
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="width: 10%;">STRUCTURE DESIGN</td> </tr> <tr> <td>Design Storm <u>D</u> year - 24 hr. = <u>1/5/</u></td> <td>cts (4)</td> </tr> <tr> <td>Hydraulic Capacity (Qa)</td> <td>= <u>155</u> cfs (5)</td> </tr> <tr> <td>Overfall Height (d)</td> <td>= <u>3.0</u> feet (6)</td> </tr> <tr> <td>Box Depth (b)</td> <td>= <u>8.0</u> feet (7)</td> </tr> <tr> <td>Box Width (w)</td> <td>= <u>2.0</u> feet (8)</td> </tr> <tr> <td>Downstream Channel Width (Wc)</td> <td>= <u>2.8</u> feet (9)</td> </tr> <tr> <td>Headwall Height Above Crest (H1)</td> <td>= <u>3.1</u> feet (10)</td> </tr> <tr> <td>Required Tailwater Depth (D2)</td> <td>= <u>2.8</u> feet (11)</td> </tr> <tr> <td>Available Tailwater Depth (D3)</td> <td>= <u>3.1</u> feet (12)</td> </tr> <tr> <td>Outlet Protection Depth (D4)</td> <td>= <u>—</u> feet (13)</td> </tr> </table>				STRUCTURE DESIGN		Design Storm <u>D</u> year - 24 hr. = <u>1/5/</u>	cts (4)	Hydraulic Capacity (Qa)	= <u>155</u> cfs (5)	Overfall Height (d)	= <u>3.0</u> feet (6)	Box Depth (b)	= <u>8.0</u> feet (7)	Box Width (w)	= <u>2.0</u> feet (8)	Downstream Channel Width (Wc)	= <u>2.8</u> feet (9)	Headwall Height Above Crest (H1)	= <u>3.1</u> feet (10)	Required Tailwater Depth (D2)	= <u>2.8</u> feet (11)	Available Tailwater Depth (D3)	= <u>3.1</u> feet (12)	Outlet Protection Depth (D4)	= <u>—</u> feet (13)
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AND STRUCTURE FOR WATER CONTROL - 587**

KS582.09 Sample of Form KS-ENG-445(JS)

TABLE OF QUANTITIES ⑦		
ITEM	UNIT	QUANTITY
Excavation	Cu. Yds.	181
Earthfill	Cu. Yds.	116
Concrete (structure only)	Cu. Yds.	7.34
Reinforcing steel	Lbs.	565
Drainfill	Tons	3.8
Inlet Protection	-	-
Riprap	Tons	3.0
Filter Fabric	Sq. Yds.	14
Outlet Protection	-	-
Filter Fabric	Sq. Yds.	13
Seeding	Acre	1

④ Benchmark Description: Top of 5/8"
Steel rod, 120 NW of Sta. 1+00 of
Channel.

⑤ Elevation 100.0

US DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE

① County Kawartha
② Record Number SM 2-22-2
③ Landuser SM FARMER

④ Date 10/10/96
⑤ Title None
⑥ Scale 1:1000

DRAINFILL GRADATION REQUIREMENTS

SIZE No.	% Passing
3/8"	100
4	95-100
8	80-100
16	50-85
30	25-60
50	10-30
100	2-10
200	0-5

Material passing the No. 200 sieve shall be non-plastic.

Notes:

- Provide 2-foot deep footing on downstream end of outlet protection when using Option A.
- Provide 3 1/4-inch preformed expansion joint filler between structure and concrete slabs when using Option A for inlet or outlet protection.
- Bedding material as shown on Option A is required only for moderate to high shrink swell potential soils.
- Provide 1-foot deep vertical imbedding of filter fabric on all edges of inlet and outlet protection when using Options B or C.
- Riprap shall consist of a well graded rock with maximum size of 30 lbs., 40 to 60 % greater than 6 lbs., and not more than 5 % of earth and rock material smaller than 1 1/2 inches.

Inlet and Outlet Protection Details

Concrete
6 x 6 welded wire fabric W2.9 x W2.9 Bedding

Option A

Concrete Blocks
Riprap Filter Fabric

Option B

Option C

Backfill Detail

REINFORCED CONCRETE BOX DROP SPILLWAY

(Drawings Not to Scale)

KS582-13

(KS210-KNKDM, Oct. 1996)

PART 582 - GRADE STABILIZATION STRUCTURE - 410
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KS582.10 Sample of Form KS-ENG-446(JS)

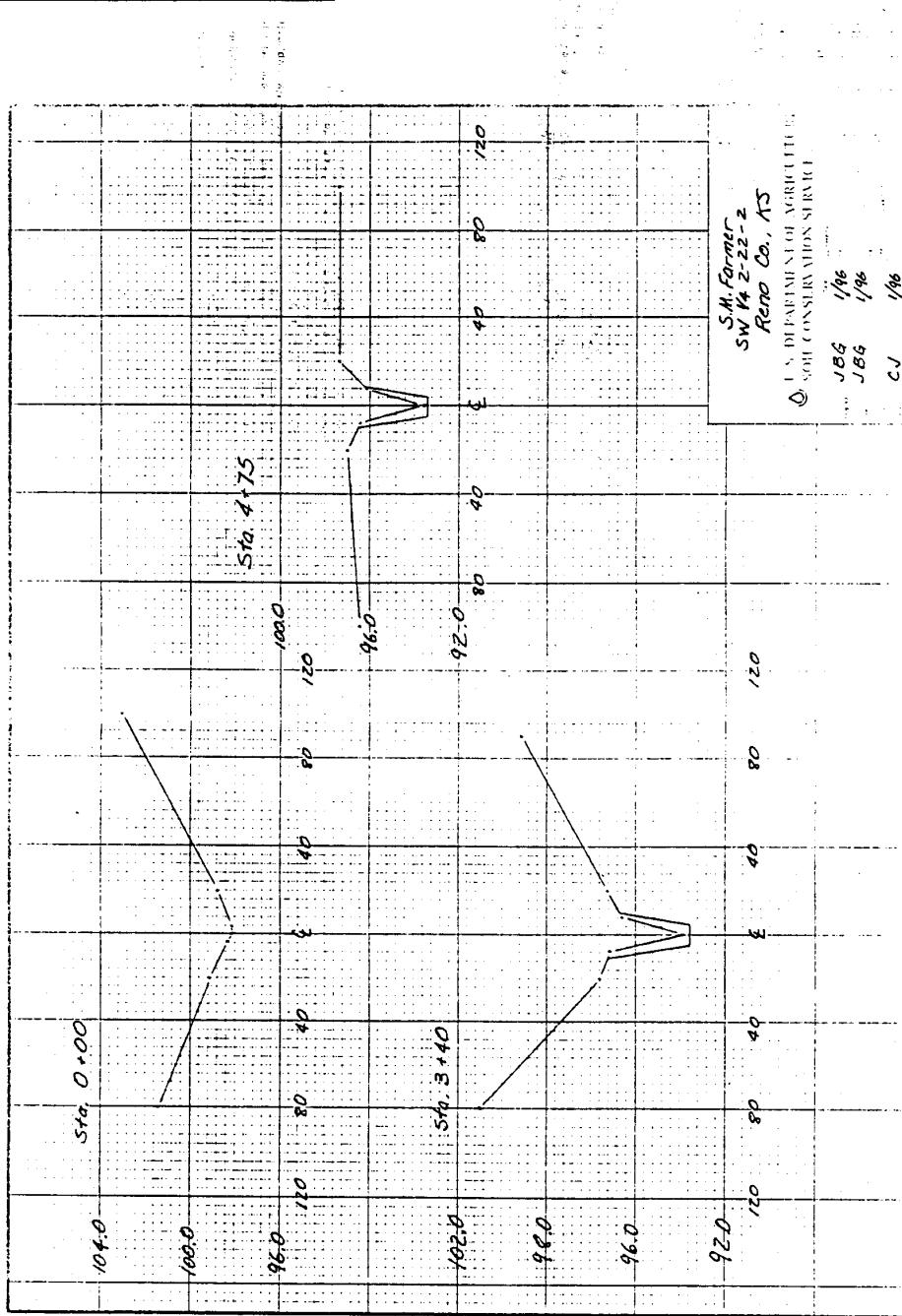
Note:	Weepholes shall be 1" diameter, spaced evenly around box at approximately 24 centers. The bottom of the weepholes shall be 1" above the floor of the box.																																																																												
[6]	<p>STEEL SCHEDULE</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th rowspan="2">MARK</th> <th rowspan="2">TYPE</th> <th rowspan="2">QUANTITY</th> <th colspan="2">A</th> <th colspan="2">TOTAL</th> </tr> <tr> <th>TYPE 1</th> <th>TYPE 3</th> <th>A</th> <th>A</th> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>4</td> <td>4</td> <td>5</td> <td>5'-0"</td> </tr> <tr> <td>2</td> <td>3</td> <td>3</td> <td>4</td> <td>4</td> <td>5</td> <td>5'-0"</td> </tr> <tr> <td>3</td> <td>3</td> <td>3</td> <td>5</td> <td>5</td> <td>5</td> <td>5'-0"</td> </tr> <tr> <td>4</td> <td>1</td> <td>30</td> <td>7</td> <td>7</td> <td>7</td> <td>7'-0"</td> </tr> <tr> <td>5</td> <td>3</td> <td>3</td> <td>5</td> <td>5</td> <td>5</td> <td>5'-0"</td> </tr> <tr> <td>6</td> <td>3</td> <td>3</td> <td>5</td> <td>5</td> <td>5</td> <td>5'-0"</td> </tr> <tr> <td>7</td> <td>3</td> <td>3</td> <td>5</td> <td>5</td> <td>5</td> <td>5'-0"</td> </tr> <tr> <td>8</td> <td>1</td> <td>4</td> <td>4</td> <td>4</td> <td>4</td> <td>4'-0"</td> </tr> </table>										MARK	TYPE	QUANTITY	A		TOTAL		TYPE 1	TYPE 3	A	A	1	1	1	4	4	5	5'-0"	2	3	3	4	4	5	5'-0"	3	3	3	5	5	5	5'-0"	4	1	30	7	7	7	7'-0"	5	3	3	5	5	5	5'-0"	6	3	3	5	5	5	5'-0"	7	3	3	5	5	5	5'-0"	8	1	4	4	4	4	4'-0"
MARK	TYPE	QUANTITY	A		TOTAL																																																																								
			TYPE 1	TYPE 3	A	A																																																																							
1	1	1	4	4	5	5'-0"																																																																							
2	3	3	4	4	5	5'-0"																																																																							
3	3	3	5	5	5	5'-0"																																																																							
4	1	30	7	7	7	7'-0"																																																																							
5	3	3	5	5	5	5'-0"																																																																							
6	3	3	5	5	5	5'-0"																																																																							
7	3	3	5	5	5	5'-0"																																																																							
8	1	4	4	4	4	4'-0"																																																																							
[7]	<p>FRONT VIEW (Not to scale)</p>																																																																												
[8]	<p>SIDE VIEW (Not to scale)</p>																																																																												
[9]	<p>Construction Joint Detail</p>																																																																												
[10]	<p>TOP VIEW (Not to scale)</p>																																																																												
[11]	<p>Reinforced Concrete Box Drop Spillway</p>																																																																												
[12]	<p>Overall Height</p>																																																																												
<p>U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE</p> <p>County: [2] [4] [3] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]</p> <p>Tech. Description: [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]</p> <p>Landowner: [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]</p> <p>Project No.: [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]</p> <p>Date: [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16]</p> <p>Form No.: KS-ENG-446(JS)</p>																																																																													

KS582-14

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KS582.11 Sample of Plotted Channel Cross Sections for Reinforced Concrete Box Drop Structures



KS582-15

(KS210-KNKDM, Oct. 1996)

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KS582.12 Terrace Outlet Structures

Design according to guidelines in the Kansas Supplement to the Engineering Field Manual, Chapter 6, and the criteria in the Kansas Standard and Specifications for Grade Stabilization Structure - 410. This section applies only to concrete structures to be used as terraces outlets. It does not apply to other areas needing grade stabilization.

KS582.13 Layout

(a) Layout for terrace outlet structures cannot be completed until the field is staked for terraces. Following layout of the terraces, record survey data for the terrace outlet structures on Forms NRCS-ENG-28 and NRCS-ENG-29 (loose leaf field notebook) or KS-ENG-37 and KS-ENG-37a. Record all the information indicated below. A sample of completed Forms NRCS-ENG-28 and NRCS-ENG-29 are shown on pages KS582-20 and KS582-21, with each circled letter on the sample form corresponding to the lettered item indicated below. Survey notes should follow the format shown on the sample notes.

(1) Complete identification information on the front side of Form NRCS-ENG-28. The location of each structure will be the outlet point for each terrace as identified during the terrace layout.

(2) Record profile survey notes. Take shots along the centerline of the channel that will connect the structures at all significant changes in slope and direction, but do not exceed 100 feet (30.5 m) between shots. It is recommended a separate bench mark be established at each structure location. Convert rod readings to elevations using a common bench mark.

(b) While in the field completing the survey, check for signs of utilities in the construction area. If utilities are known to exist, safety procedures in National Engineering Manual Part 503 should be strictly followed.

KS582.14 Design

(a) Hydrology - Use the reverse side of Form KS-ENG-137, Hydrologic Summary Sheet, or EFM2 computer program to record the hydrologic data for the structure's drainage area and to compute the peak discharge in cubic feet per second (cfs) for each structure. Runoff from a 10-year, 24-hour frequency rainfall will normally be used for design. Examples of completed Form KS-ENG-137 and EFM2 computer program printouts are shown on pages KS582-22 through KS582-24.

(b) Hydraulic Design - Determine the appropriate weir elevation for each structure. The weir crest of each terrace outlet structure must be the same elevation as the terrace outlet, which is often located at 1 foot (0.3 m) below the plotted field elevation. This 1 foot (0.3 m) depth could vary

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depending upon such factors as terrace alignment, cut or fill, etc. Designers are to fill in the reverse side of KS-ENG-7 to determine appropriate weir elevations. A sample plot is shown on page KS582-30.

From the plotted profile and computed discharge for each structure, use the "Hydraulic Capacity" table shown on Form KS-ENG-438(JS), Kansas Supplement to Engineering Field Manual, Chapter 6, to determine the height and width necessary for each structure to carry the computed discharge. Select the total fall, F, in the structure. This F dimension will be used to establish the sill elevation for each structure. The sill of an upper structure must not be more than 0.5 foot (.15 m) above the weir crest of the next lower structure, unless there is grade of 0.3 percent or less between the structures. Complete Form KS-ENG-438(JS) for each structure. It may be more convenient to reduce Form KS-ENG-438(JS) to 8.5 inches by 11 inches (216 x 279 mm). Samples of completed Form KS-ENG-438(JS) are shown on pages KS582-25 through KS582-27.

For structures installed in series, no structure shall have less capacity than the structure immediately upstream.

(c) Form KS-ENG-7, Terrace Outlet Structure Field Sheet - Record Items (1) through (15) on the front side of this field sheet and Items (16) through (21) on the reverse side of this sheet. A sample of a completed front side of Form KS-ENG-7 is shown on page KS582-29 and a sample of the reverse side is on page KS582-30. Each circled number on the form corresponds to the numbered item below:

- (1) Name of owner/operator
- (2) Identification number - The tract number or a number assigned for cost-share program identification may be recorded in this blank.
- (3) Legal description
- (4) County name
- (5) Field number
- (6) Complete the sections on type of concrete and class of concrete to be used for the terrace outlet structures.
- (7) The "Remarks" section may be used to indicate any information specific to the job.
- (8) Indicate the status of any utilities in the construction area. Indicate "yes" if utilities are present and "none known" if there are no records, maps or on-site markers that indicate the presence of utilities.

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- (9) Complete the location map by showing the location of the terraces; terrace outlet structures; known utilities and any other pertinent features such as streams, roads, farmsteads, etc.
- (10) List the scale of the location map.
- (11) Complete the design section containing "Structure Number," "Capacity," "Dimensions" (H, F, L), steel quantities and concrete quantities from Form KS-ENG-438 for each structure. Sum the steel and concrete quantities for all the structures to obtain the total quantities needed for the job.
- (12) Signature of the person performing the layout and the date
- (13) Signature of the person performing the design and the date
- (14) Signature of the person checking the design and the date
- (15) Signature of the person approving the design and the date
- (16) Record structure number in each flag.
- (17) Record station of each structure.
- (18) Record flag elevation at each structure.
- (19) Record weir elevation of each structure.
- (20) Record sill elevation of each structure.
- (21) Record grade between the structures. If a single structure is being used, this is the grade to the stable outlet area.
- (22) Record outlet elevation.
- (23) Record the bench mark elevation and a description for each structure.

KS582.15 Checkout

- (a) Form KS-ENG-7, Terrace Outlet Structure Profile & Checkout (reverse side) - Record the following items on the field sheet. A sample of a completed field sheet is shown on page KS582-30.
 - (1) Complete the "Checkout Information" block, which consists of backsights, height of instrument, foresight and elevation for each structure.
 - (2) Name of the person completing the checkout and the date

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(3) Name of the person completing the audit and the date

(b) Form KS-ENG-438(JS), Terrace Outlet Structure - Use this form to record as-built dimensions for each structure. Dimensions that are the same as designed can be shown with a check mark beside that dimension. Show any differences from design to checkout by recording the checkout dimension on the plans. The person completing the checkout should sign and date the checkout. Samples of completed Form KS-ENG-438 are shown on pages KS582-25 through KS582-27.

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KS582.16 Sample of Form NRCS-ENG-28

U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
SCD	RENO
Field Office	50 MTC
Name	John Doe
Individual	<input checked="" type="checkbox"/>
Group	<input type="checkbox"/>
Unit of Govt.	<input checked="" type="checkbox"/>
(circle one)	
Job	TERRACE OUTLET STRUCTURES
Design Sur.	<input checked="" type="checkbox"/>
Const. Layout	<input checked="" type="checkbox"/>
Const. Check	<input type="checkbox"/>
Other	<input type="checkbox"/>
Ident. No.	Field No.
SEE ATTACHED	
FIELD SHEET	
Scale	
1"	
Legal Description	
New	Sec 33 T 24 R 7
or	
Location:	

SCS-ENG-28 REV. 5-75

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KS582.17 Sample of Form NRCS-ENG-29

Station	B.S.	H.I.	F.S. or grade rod	Elev. or planned elev.
BM #1	1.8	51.8		50.0
0+00			0.8	51.0
1+00			2.2	49.6
2+00			3.6	48.2
2+75			4.2	47.6
3+75			5.7	46.1
4+75			6.9	44.9
5+65			7.8	44.0
6+65			9.2	42.6
7+65			10.6	41.2
8+65			12.1	39.7
8+90			12.7	39.1
BM #2			6.8	45.0

SCS-ENG-29 (2-80)

GPO : 1982 O - 369-853

John Doe Terrace Outlets
Design Survey

Blow π
Jones ϕ
2/5/93

Top of 1"x2" wooden hub 50' downstream
of structure #1.

Structure #1

Structure #2

Structure #3

Top of 1"x2" wooden hub 75' downstream
and 150' to the right of structure #3.

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KS582.18 Sample of EFM2 computer program

EFM-2 ESTIMATING RUNOFF AND PEAK DISCHARGE

VERSION 1.00

Client : John Doe
 County : Reno
 Practice: Terrace Outlet Structure #1

By: JS
 Checked: BL

Date: 02-05-93
 Date: 2/5/93

Drainage Area : 6.3 * Acres
 Curve Number : 66 *
 Watershed Length : 1500 Feet
 Watershed Slope : 3.5 Percent
 Time of Concentration: .581 Hours
 Rainfall Type : II

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	2	5	10	25	50	100	0
24-Hr Rainfall (in)	3.2	4.2	5	5.8	6.6	7.4	0
Ia/P Ratio	0.32	0.25	0.21	0.18	0.16	0.14	0.00
Runoff (in)	0.64	1.21	1.73	2.29	2.89	3.52	0.00
Unit Peak Discharge (cfs/acre/in)	0.602	0.666	0.693	0.712	0.726	0.737	0.000
Peak Discharge (cfs)	2	5	8	10	13	16	0

* - Value(s) provided by CN subroutine (F9)

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EFM-2 ESTIMATING RUNOFF AND PEAK DISCHARGE
Curve Number Computation

VERSION 1.00

Client : John Doe By: JS Date: 02-05-93
County : Reno State: KS Checked: By Date: 2/2/93
Practice: Terrace Outlet Structure #1

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
AMC CONDITION				
AMC I +.8 (II-I) Sm Grain(Con & Gr Terr)	-	6.3 (66)	-	-
Total Area (by Hydrologic Soil Group)	6.3			
	=====			
TOTAL DRAINAGE AREA: 6.3 Acres		WEIGHTED CURVE NUMBER: 66		

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KS582-23

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KS582.19 Sample of KS-ENG-137 for practices with multiple reaches

HYDROLOGIC SUMMARY SHEET FOR WATERWAYS

Waterway	Hydrologic Group	Cover Description (Practices or Condition)	Wt. CN	Area, acres (CN X A)	Product CN	Wt. CN	Hyd. Length, ft.	Y, Avg. WS Slope, %	Tc, hrs.	10 yr. Rainfall, inches	Q, Runoff in. /inches	Ia, Iw/P	qu, Unit Discharge, cfs/ft	O _p = (au/A)Q
Reach A	B	5m Grn. Cont. ; Grad. Terr.	6.3	415.8										
		Total for Reach A →	6.3	415.8	6.6	1500	3.57	(1) 347.5 (2) 2433 (3) 19219	3.5	0.58	5.0	1.73	1.03	0.206
B	B	5m Grn. Cont. ; Grad. Terr.	6.6	7.2	475.2									
		Total for Reaches A & B →	13.5	891.0	6.6	1800	3.57	(1) 402.0 (2) 14975 (3) 19219	3.0	0.73	5.0	1.73	1.03	0.206
C	B	5m Grn. Cont. ; Grad. Terr.	6.6	7.2	475.2									
		Total for Reaches A, B & C →	20.7	1366.2	6.6	2100	3.57	(1) 454.5 (2) 1715 (3) 19219	3.0	0.82	5.0	1.73	1.03	0.206
D														
		Total for Reaches A, B, C & D →					(2)	(1) _____ (2) _____ (3) _____	(4) _____					
E														
		Total for Reaches A, B, C, D & E →					(2)	(1) _____ (2) _____ (3) 1140 Y ~0.7	(4) _____ (5) _____ (6) _____					

$$(1) \lambda \sim 0.8$$

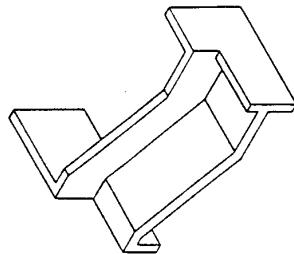
$$(2) [(100/CN) - 9]^{0.7}$$

$$(3) 1140 Y \sim 0.5$$

$$T_c = \frac{0.8 [(1000/CN) - 9]^{0.7}}{1140 Y^{0.5}}$$

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KS582.20 Samples of Completed Form KS-ENG-438(JS)

 <p align="center">HALF ISOMETRIC VIEW</p> <p>PLAN VIEW</p> <p>Steel bar to be placed in both side walls 2' from top and bent 15° into headwall and tailwall of all structures.</p> <p>Steel bar</p> <p>Dimensions: 6'-0" x 4'-0" x 3'-6" x 3'-6"</p>	<p align="center">TABLE OF CAPACITY AND QUANTITY</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>H ft</th> <th>F ft</th> <th>L ft</th> <th>Capacity Concrete Volume cu. ft.</th> <th>Reinforcing Steel cu. in.</th> <th>Welded Wire Fabric 6x6-W2.9-W2.9</th> </tr> </thead> <tbody> <tr> <td>1.5</td> <td>3.0</td> <td>4.0</td> <td>12.4</td> <td>3.80</td> <td>2.7 - 4 At-Needed</td> </tr> </tbody> </table>	H ft	F ft	L ft	Capacity Concrete Volume cu. ft.	Reinforcing Steel cu. in.	Welded Wire Fabric 6x6-W2.9-W2.9	1.5	3.0	4.0	12.4	3.80	2.7 - 4 At-Needed	<p align="right">H = 1.5 F = 3.0 L = 4</p> <p align="right">TERRACE OUTLET STRUCTURE</p> <p align="right">John Doe - Structure # 1</p> <p align="right">NW 1/4 33-24-7</p> <p align="right">Reno County, Kansas</p> <p align="right">U.S. DEPARTMENT OF AGRICULTURE Soil Conservation Service</p> <p align="right">D. Brown, P.E., Engineer T. Jackson, C.E., Inspector 7/13/96</p> <p align="right">At-Needed</p> <p align="right">7/13/96</p>
H ft	F ft	L ft	Capacity Concrete Volume cu. ft.	Reinforcing Steel cu. in.	Welded Wire Fabric 6x6-W2.9-W2.9									
1.5	3.0	4.0	12.4	3.80	2.7 - 4 At-Needed									

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KS582-25

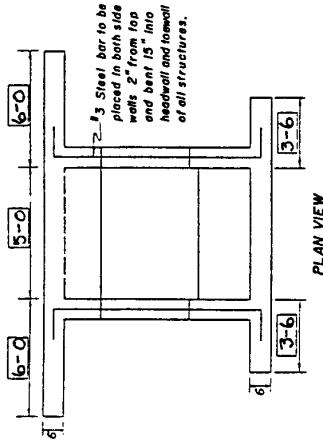
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KS-ENG-438 (US) 9/86

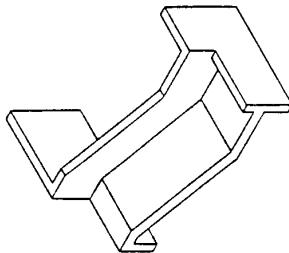
USDA - SCS

NOTES:

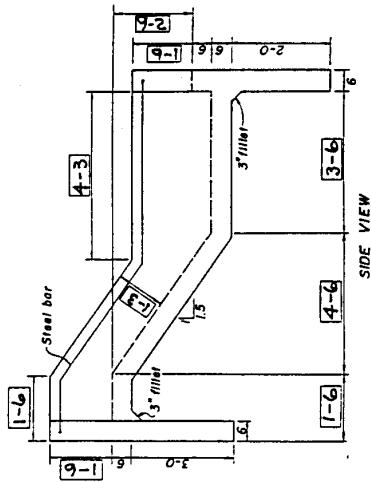
1. The foundation soil shall be firm and uniform.
2. No water is to be ponded in front of the structure.
3. All concrete shall be 6" thick.
4. Use 3000 psi (min.) concrete at 28 day test, with air-entainment.
5. All steel to be 3 steel bars on 12" C-C.
- 6x6 - W2.3w2.9 (6x6-6x6) welded wire fabric may be substituted if all joints are double reinforced by tops of 12" or more.
6. Steel shall have a minimum of 2" of cover, 1.3" when against earth.
7. All steel shall be accurately placed and adequately supported before concrete is placed.
8. All tops to be 15" or more.
9. Steel in slope and apron shall be bent into sawtooths.
10. Steel in sidewalls shall be bent into steps and aprons.



PLAN VIEW



HALF ISOMETRIC VIEW



SIDE VIEW

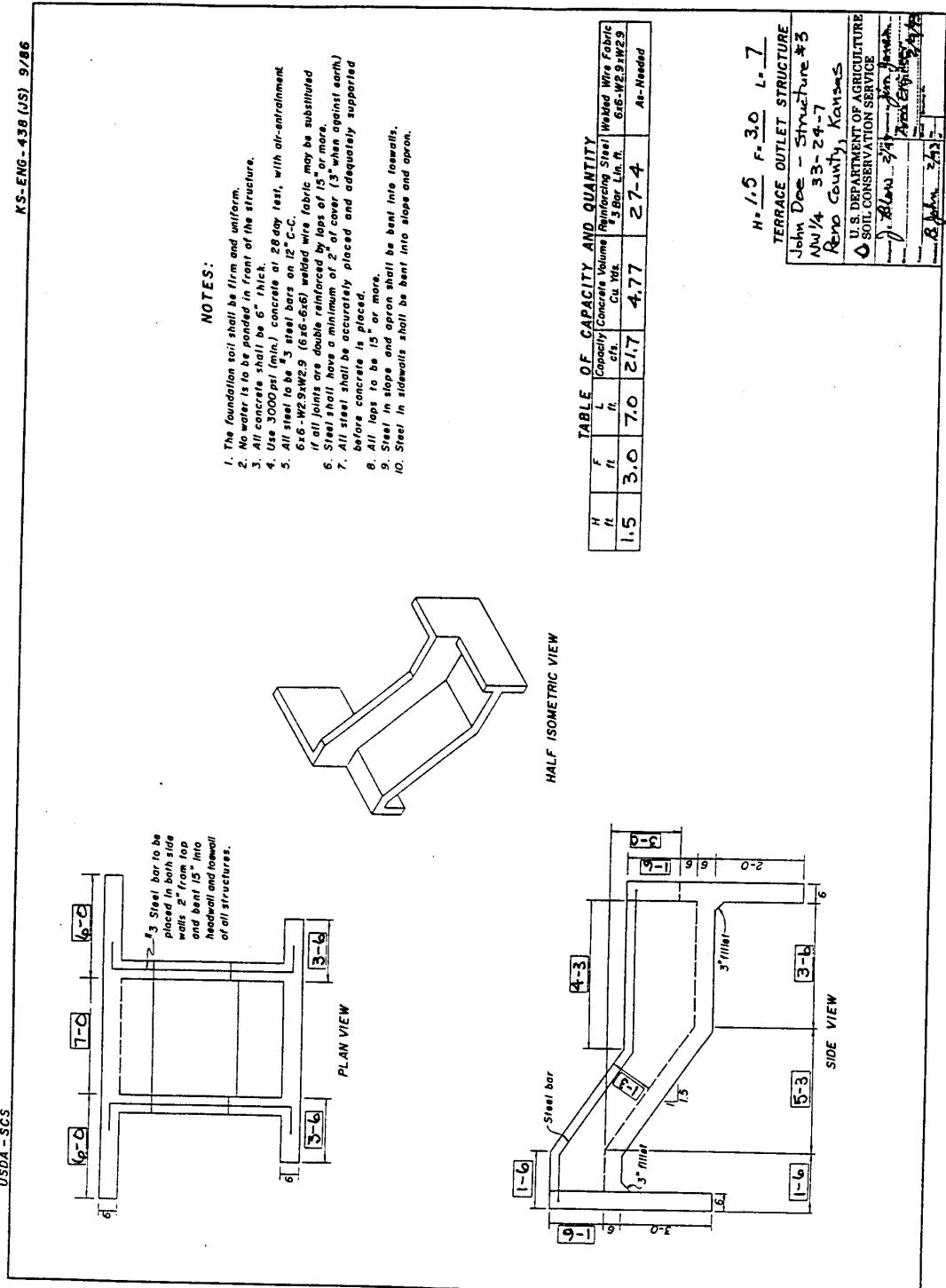
H	F	L	Capacity Concrete Volume	Quantity	Reinforcing Steel	Welded Wire Fabric
n	n	n	cfs.	Cu. Yds.	3 Bar Lm. ft.	6x6-W2.9x12.9
1.5	2.5	5.0	15.5	3.98	25-8	As-Needed

TERRACE OUTLET STRUCTURE			
John Deere	Structural H2		
Nw 1/4	33-24-7		
Reno County, Kansas			
U.S. DEPARTMENT OF AGRICULTURE			
SOIL CONSERVATION SERVICE			
J. R. Deere	33-24-7		
Area Engineer			
1/2	1/2		

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PART 582 - GRADE STABILIZATION STRUCTURE - 410
AND STRUCTURE FOR WATER CONTROL - 587

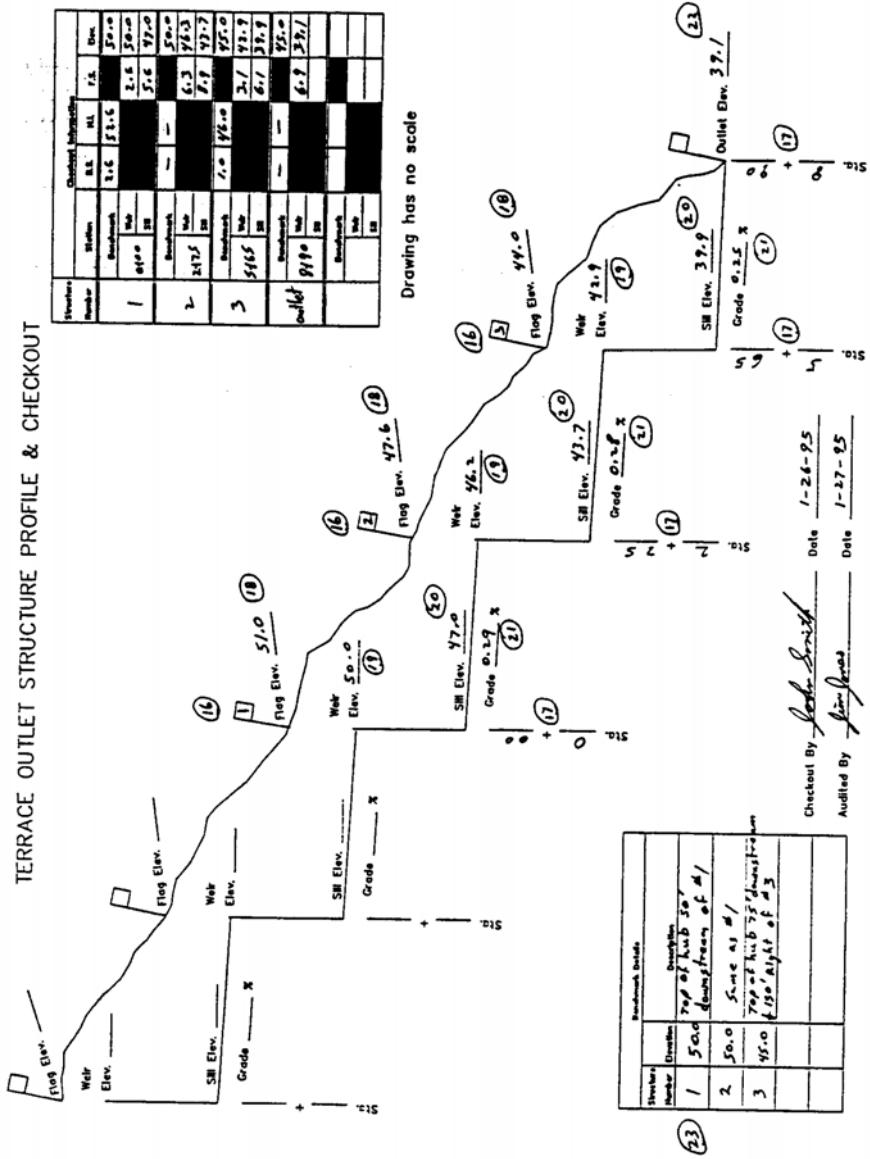
KS582.21 Sample of Form KS-ENG-7

USDA NRCS	TERRACE OUTLET STRUCTURE FIELD SHEET			KS-ENG-7 10/96	
Owner	John Doe	①	Ident. No.	Tract #1234 ②	
Legal Desc.	NW 1/4 33-24-7 ③		County	Reno ④	
Field No.	1 ⑤		Location Map		
⑥ Cement Type	I or II				
Class	3000				
⑦ Remarks					
⑧ Buried Utilities Present?					
Yes	None Known	<input checked="" type="checkbox"/> X			
Scale 1" = 1320' ⑩					
⑪ Structure Number	Capacity, cfs	Dimensions (feet)	Materials		
1	12.4	H 1.5 Fall, F 3.0	Width, L 4.0	Steel, ft-in 27-4	Concrete, cu yds 3.80
2	15.5	H 1.5 Fall, F 2.5	Width, L 5.0	Steel, ft-in 25-8	Concrete, cu yds 3.98
3	21.7	H 1.5 Fall, F 3.0	Width, L 7.0	Steel, ft-in 27-4	Concrete, cu yds 4.77
*Taken from Standard Drawing No. KS-ENG-43B (JS)					
Totals				80-4	12.55
⑫ Layout Completed By	<u>John Smith</u>			Date 2-5-93	
⑬ Design Completed By	<u>John Smith</u>			Date 2-5-93	
⑭ Design Checked By	<u>Bill Jones</u>			Date 2-9-93	
⑮ Design Approved By	<u>Bill Jones</u>			Date 2/9/93	

(KS210-KNKDM, Oct. 1996)

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